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Description

MICROTUBES FOR SURGERY AND DENTISTRY

BACKGROUND OF INVENTION

[0001] The present invention relates to the fields of medicine and dentistry. More particularly, the invention relates to microtubes for surgical and dental procedures.

SUMMARY OF INVENTION

[0002] In general, the present invention in a first aspect provides a microtube for surgery and dentistry. A first embodiment of the microtube comprises a tubular member having anterior and posterior ends; an interior axial opening extending from the anterior to the posterior end of the tubular member; and a side port disposed at the anterior end of the tubular member, and constructed and arranged for connecting the axial opening to a site of a surgical or dental procedure, and for delivery to the site of a therapeutic agent to be used for the surgical or dental procedure.

[0003] A second embodiment of the microtube comprises a tubular member having anterior and posterior ends; a port disposed at the anterior end of the tubular member; and an inner core of a material capable of transmitting a laser beam, the inner core extending from the posterior end through the port at the anterior end of the tubular member.

[0004] In a second aspect, the invention provides a method for transmitting a therapeutic agent to a site of a surgical or dental procedure. The method comprises (a) providing a microtube comprising a tubular member having anterior and posterior ends; an interior axial opening extending from the anterior to the posterior end of the tubular member; and a port disposed at the anterior end of the tubular member, and constructed and arranged for connecting the axial opening to the site of the surgical or dental procedure, and for delivery to the site of the therapeutic agent to be used for the surgical or dental procedure; (b) connecting the port of the tubular member to the site of the surgical or dental procedure; (c) connecting the axial opening at the posterior end of the tubular member to the source of the therapeutic agent; and (d) delivering the therapeutic agent to the site of the surgical or dental

procedure.

[0005] In a third aspect, the invention provides an improved procedure for a root canal. Current dental practice for carrying out a root canal comprises drilling, mechanical canal debridement, and chemical canal debridement. The improvement comprises (a) providing a microtube comprising a tubular member having anterior and posterior ends; a side port disposed at the anterior end of the tubular member, and an inner core of a material capable of transmitting a laser beam, the inner core extending from the posterior end through the port at the anterior end of the tubular member; (b) disposing the side port of the tubular member at the site of the root canal; (c) disposing the axial opening at the posterior end of the tubular member at the source of the laser beam; and (d) delivering the laser beam through the port to the site of the root canal, thereby combining the mechanical canal debridement and the chemical debridement into a single procedure, enabling removal of pulpal tissue in three-dimensional volume elements which files and other instruments cannot reach, and sterilizing the canal and ablating the pulpal tissue.

Brief Description of Drawings

[0006] *FIG. 1* is a schematic representation of a first embodiment of a microtube for surgery and dentistry, made in accordance with the principles of the present invention.

[0007] *FIG. 2* is a schematic representation of a second embodiment of a microtube for surgery and dentistry, made in accordance with the principles of the present invention.

DETAILED DESCRIPTION

[0008] More specifically, reference is made to *FIG. 1,* in which is shown a first embodiment of a microtube for surgery and dentistry, made in accordance with the principles of the present invention, and generally designated by the numeral *2*.

[0009] The microtube *2* comprises a tubular member *3* having anterior and posterior ends *3a* and *3b*, respectively; an interior axial opening *4;* and front and side ports *6* and *8*, respectively, constructed and arranged for connecting the axial opening to a site of a surgical or dental procedure, and for delivery to the site of a therapeutic agent *10a* being used for the surgical or dental procedure. Instead of a single axial opening a plurality of openings may be utilized, and are often beneficial. The posterior end *3b* of the tubular member *3* is provided with means *12* for connecting the microtube *2* to a source *10* of the therapeutic

agent *10a*. The microtube *2* has an outside diameter (o.d.) of from about ten to about one hundred microns, and an inside diameter (i.d.) of from about five to about fifty microns. These dimensions are critical for optimum functioning of the microtube *2*. Preferably, the microtube *2* has a length of from about twenty to about twenty-five millimeters.

[0010] During the surgical or dental procedure, the microtube *2* is connected to the source *10* of the therapeutic agent *10a*, which is generally pressure, vacuum, or a pharmaceutical agent, and the therapeutic agent *10a* is transmitted through the microtube *2* to the site of the surgical or dental procedure via the axial opening *4* and or or both ports *6* and/or *8*.

[0011] The pharmaceutical agent is usually an antibiotic, a chemotherapeutic agent, or a sealant. The length of the microtube *2* is preferably from about twenty to about twenty-five millimeters, but the length is not critical.

[0012] Because of its extreme microsize, which is critical, the microtube *2* does not harm tissue when used to transmit pressure, vacuum, or pharmaceuticals to the site being operated upon, and is especially suited for surgical and dental procedures such as a root canal and surgical oper-

ations involving extremely limited space.

[0013] Because of the provision of front and side ports, the microtube *2* provides versatility in enabling the surgeon, dentist, or oral surgeon to reach various areas of limited accessibility at the site of the surgical or dental procedure.

[0014] The combination of multiple ports disposed perpendicularly to one another, and of the extremely small dimensions of the microtube *2*, the microtube *2* provides a unique instrument for surgeons, dentists, and oral surgeons performing operations in a space limited both in area and in accessibility.

[0015] Reference is now made to *FIG. 2*, in which is shown a second embodiment of a microtube for surgery and dentistry, made in accordance with the principles of the present invention, and generally designated by the numeral *20*.

[0016] The microtube *20* comprises a tubular member *23* having anterior and posterior ends *23a* and *23b*, respectively; an interior axial opening *24*; front and side ports *26* and *28*, respectively; and an inner core *25* of a material capable of transmitting a laser beam from a source *30*, the inner core *25* extending from the posterior end *23b* through the ports *26* and *28* at the anterior end *23a* of the tubular member *23*. The dimensions of the microtube *20* are the same as

those of the microtube *2*.

[0017] The microtubes *2* and *20* comprise a metal tube made by metallic electrodeposition. The side ports *8* and *28* provide extreme versatility by virtue of their being capable, by rotation of the microtubes *2* and *20* about their longtitudinal axes, of dispsosing the ports *8* and *28* in a perimeter of about one hundred and eighty degrees.

[0018] A particularly important application of the present invention is the provision of an improved procedure for doing a root canal. Use of the microtube *20* as a side-firing laser tube combines mechanical canal debridement and chemical canal debridement into a single procedure. It is presently virtually impossible to clean thoroughly a root-canal system with instruments alone. The use of chemical debridement enables removal of vital and/or nonvital pulpal tissue in three-dimensional volume elements which files and conventional instruments cannot reach. A couple of passes of the side-firing laser tube *20* to the apex of the tooth will clean, debride, and sterilize the site to a greater extent than any existing combination of state-of-the-art procedures. The side-firing laser tube *20* is so small that it will go all the way down to the apex of the tooth without the need for canal enlargement. It will then

sterilize the canal and ablate all pulpal tissue. Obturation is accomplished with a modified hydrophilic mineral trioxide aggregate canal sealant delivered through side *8* and/or front *6* ports of the microtube *2* .

[0019] Because both the focal length and the wavelength of the laser beam are adjustable, the beam is capable of ablating diseased tissue in conformity with the focal length that is set. This can be done without harm to non-diseased, healthy tissue in very hard-to-reach, relatively inaccessible areas. Such areas cannot be reached or accessed with and by an instrument as small as the smallest needle probe. This microtube laser technology enables early surgery, limited only by early diagnosis.

[0020] While certain embodiments and details have been described to illustrate the principles of the present invention, it will be apparent to those skilled in the art that many modifications are possible without departing from the spirit and scope of the invention.